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U. S. NAVAL AIR DEVELOPMENT CENTER
JOHNSVILLE, PENNSYLVANIA

Anti-Submarine Warfare Laboratory

REPORT NO. NADC-AW-N6208 - TECHNICAL NOTE, NAVAIRDEVCEN AIRBORNE INFRARED DEVELOPMENTS (U)

WEPTASK NO. RUDC4B000/2021/FC01-05-002
Problem No. 204

P. M. Moser

8 June 1962

Transcript of a talk given by Mr. Paul M. Moser to visitors to the Naval Air Development Center on 17 January 1962.

(b)(6)

Director

~~DISTRIBUTION STATEMENT~~

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16. SUPPLEMENTARY NOTATION
Transcript of a presentation given on 17 Jan 1962

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FIELD	GROUP	SUB-GROUP

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Wake	Surface Effects	Antisubmarine	Thermal
Detection	Infrared	Nonacoustic	Sea Surface

19. ABSTRACT (Continue on reverse if necessary and identify by block number)
This report describes the AN/AAD-2 infrared line-scanning equipment, its installation in P2V-5F aircraft BuNo 131403, and some results obtained with it in the course of investigating the detectability of wakes generated by submarines. The report includes infrared imagery of wakes generated by the midget submarine USS X-1 operating completely submerged at a keel depth of 30 ft in Chesapeake Bay, of a two-mile-long wake of a snorkelling submarine, and of natural sea surface thermal background patterns in the Atlantic Ocean.

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PAUL M. MOSER	(215) 441-1873	50C

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TECHNICAL NOTE
NAVAIRDEVCEN AIRBORNE INFRARED DEVELOPMENTS (U)

P. M. Moser

Two months ago I had the privilege of speaking to a number of you on the subject of airborne infrared oceanographic mapping. On that occasion I discussed passive infrared mapping devices, which can produce thermal pictures of objects under surveillance---even in absolute darkness---by virtue of small temperature differences they exhibit. In these thermal pictures warm objects appear light and cool objects appear dark.

On that earlier occasion I pointed out the value of an infrared imaging device as an oceanographic instrument. Infrared pictures of thermal anomalies in the water were shown---such as this overflow of cold fresh reservoir water into the ocean (figure 1)---and this cloud-like thermal structure in the water (figure 2), which suggested the possible use of infrared mapping for predicting sonar ranges. (The two parallel dark lines are due to a crimping of the recording film and are to be disregarded.) It was also pointed out that an infrared system could be used for nighttime detection and partial classification of ships at sea---as this infrared picture of a destroyer illustrates (figure 3).

Since the principal objective of the group that I represent is the development of a device for detecting submerged submarines by detecting effects they produce on the sea surface, it is appropriate that on this occasion I discuss the instruments we are using and some of the results that we have obtained with them against submarines.

The operation of our basic system is illustrated in this diagram (figure 4). All objects radiate infrared energy at a rate dependent on their absolute temperatures. A small portion of the infrared radiation emitted by the objects under surveillance is intercepted by this scanner mirror, which is mounted on a rotating shaft whose axis is parallel to the flight path of the aircraft. As the scanner rotates, radiant energy from each object point along a line perpendicular to the flight path is sampled sequentially and focused by means of a parabolic mirror onto an infrared detector maintained at liquid nitrogen temperature. In the detector an electrical signal proportional to the impinging infrared radiation is generated. This signal is amplified and passed on to a glow tube which emits light whose intensity is proportional to the electrical signal impressed on it. Light from the glow tube is focused to a small spot by means of a microscope objective, which is also mounted on the rotating shaft. The intensity-modulated spot of light scans across a piece of slowly-advancing photographic film in synchronism with the scanner. As the aircraft advances, a wide-angle 120° field of view is swept out by the scanner and recorded on photographic film in the form of a continuous strip map.

Here we see a picture of the 43-pound basic AN/AAD-2 system installed over a small opening in the closed-off bomb bay of a P2V aircraft (figure 5). In the after section of the aircraft we see some accessory units including a KD-14 camera-processor-viewer (figure 6). Video information from the scanner is also recorded on photographic film in the KD-14. This film is rapid-processed continuously and passed over an illuminated viewing screen so that an observer sees a continuously advancing infrared picture of the terrain below with a delay of about ten seconds. An immediate display in either A-scope or B-scope form is also available on this small oscilloscope.

Here are some results obtained with the AN/AAD-2. This is a 2-mile long cool wake generated by a snorkeling submarine (figure 7). It appears that, in this case, the mechanism of wake formation is a stirring of cool subsurface water to the surface by the submarine.

Next we will see a series of infrared pictures recorded in an exercise conducted in conjunction with the Naval Research Laboratory in the vicinity of the Chesapeake Bay Bridge near Annapolis. The 8-foot diameter midget submarine SSX-1, which participated in the exercise, is seen north of the bridge as a cold spot with a warm wake, prior to submerging at the beginning of the first event (figure 8). The bridge is seen as a cold dark line---the little lumps along the bridge are supporting piers. The two bright spots on the bridge correspond to the warm engine hoods of vehicles. A patrol vessel which also participated in the exercise is standing by south of the bridge. This picture was recorded at the time of high slack water. Note the curious thermal patterns on the surface of the water.

This picture was recorded on the next aircraft pass, 5 minutes after the preceding one (figure 9). In the meantime, the midget submarine has submerged to a keel depth of 30 feet and is heading toward the bridge at a speed of 3 knots---leaving a warm wake as it proceeds.

This picture was recorded on the next pass 6 minutes after the preceding one (figure 10). The advance of the submerged submarine can be followed by the advance of the wake pattern.

This infrared picture was recorded at the beginning of the next event, which was conducted south of the bridge about 1-1/4 hours after high slack water (figure 11). Warm wakes generated by the submerged submarine and the patrol vessel are readily distinguishable against the rather complicated natural thermal background of the bay. V-shape wakes due to motion of the slowly ebbing tide waters about the bridge piers can be seen.

When these Chesapeake Bay pictures were recorded during November 1961 the sensitivity of the AN/AAD-2 was such that extended area target temperature differences as small as 0.01C° could be detected. Since that time new infrared detectors having a greater sensitivity have been

procured and the AN/AAD-2 is being modified to accept them. This picture shows the metamorphosis of the AN/AAD-2 toward the more sensitive configuration (figure 12). The principal change has been the addition of a mercury doped germanium detector which, when used currently, is maintained at its required very low operating temperature by use of liquid helium. If the performance of this detector meets expectations, a closed-cycle liquid neon cooler will be procured to provide adequate cooling of the detector and eliminate the need for handling liquid helium. This picture shows the modified equipment as it will appear in use (figure 13). It is expected that the current series of modifications and laboratory tests will be completed within the next 2 weeks and that flight trials will begin thereafter.

In the event that these flight trials yield favorable results, serious consideration should be given to conducting a fleet evaluation of this type of device.

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P. M. Moser

FIGURE 1 - Infrared Picture Recorded by AN/AAD-2 of Takanassee Lake Reservoir Overflow into the Atlantic Ocean

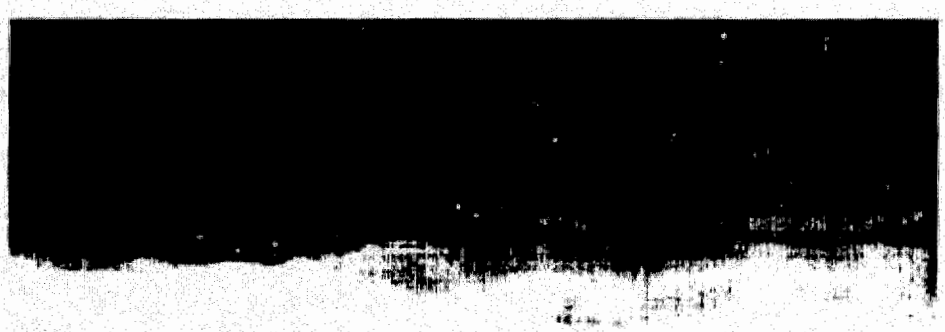

FIGURE 2 - Infrared Picture of a Natural Sea Surface Thermal Background Pattern and Submarine on the Surface

FIGURE 3 - Infrared Picture of a Surface Vessel with Two Hot Stacks

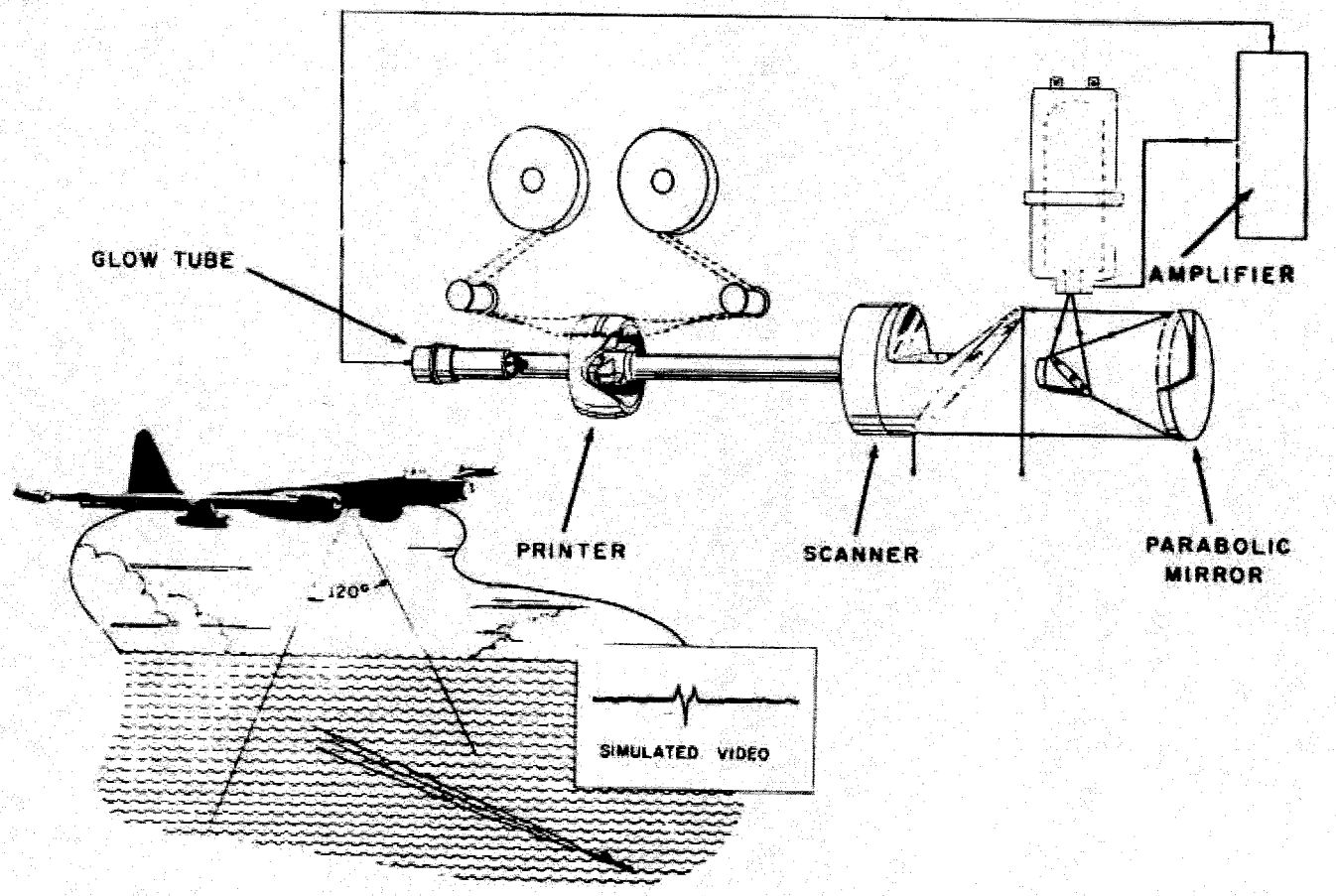

FIGURE 4 - Schematic Drawing of Infrared Detecting Set AN/AAD-2

FIGURE 5 - View of AN/AAD-2 Installed in Closed-Off Bomb Bay of P2V-5F Aircraft BuNo 131403

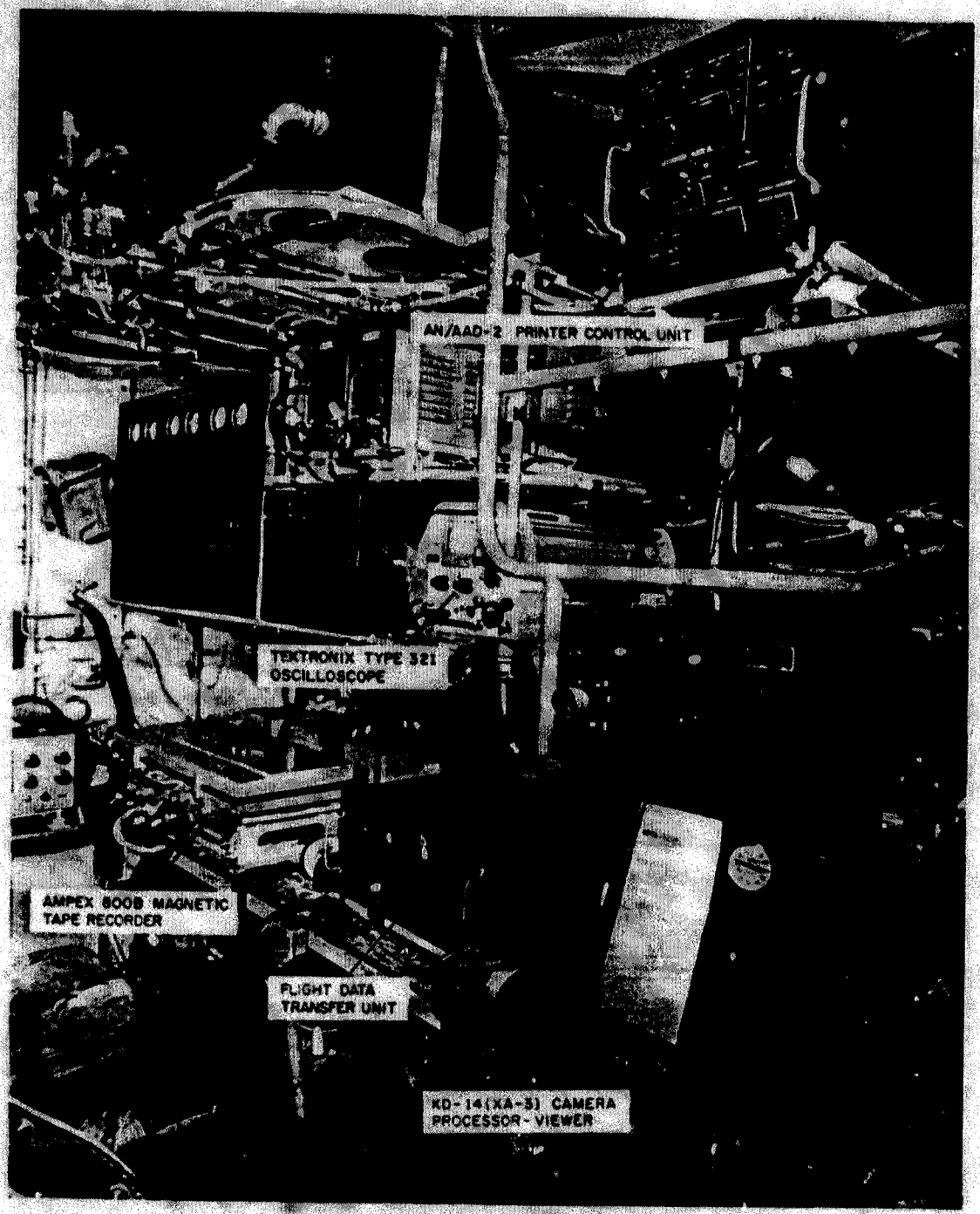

FIGURE 6 - View of After Section of P2V Aircraft

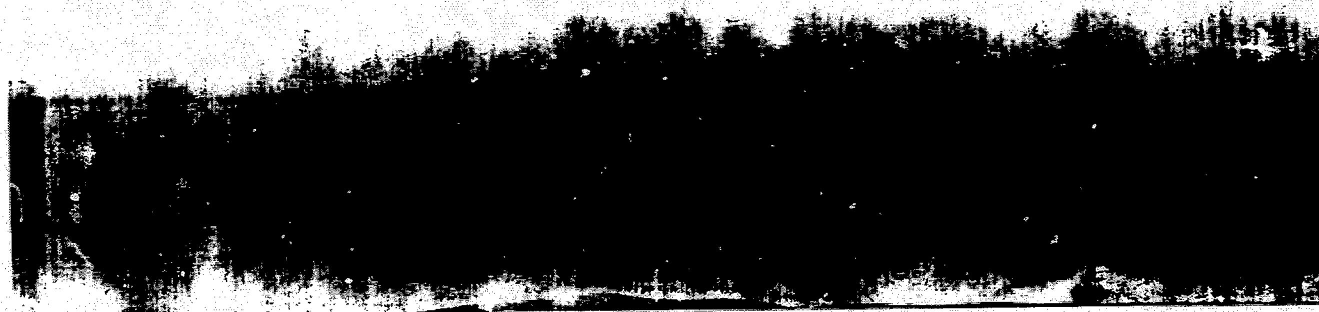

FIGURE 7 - Infrared Picture of a Two Mile Long Cool Wake Generated by a Snorkeling Submarine

FIGURE 8 - Infrared Picture Recorded Over Chesapeake Bay Bridge Showing Midget Submarine SSX-1 on the Surface (Black Dot), Patrol Vessel, and Natural Background Pattern

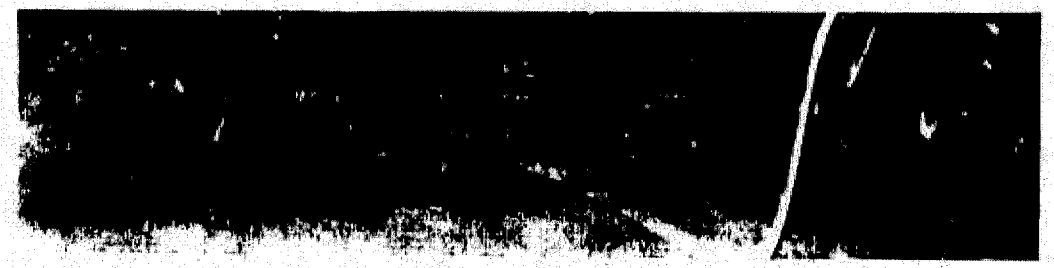

FIGURE 9 - Infrared Picture Showing Warm Wake Generated by Midget Submarine Immediately After it Submerged

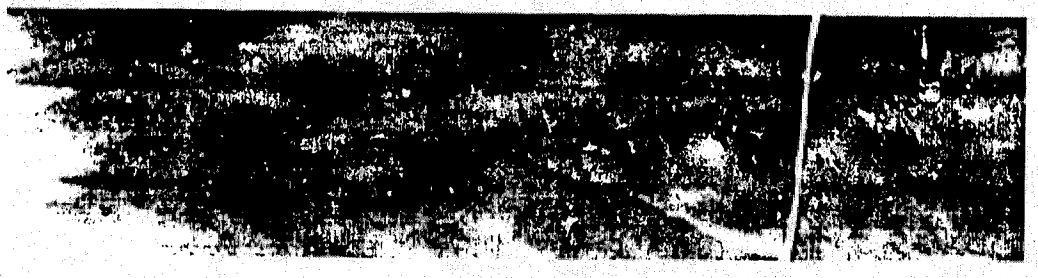

FIGURE 10 - Infrared Picture Showing Warm Wake Generated by Midget Submarine Advancing at 3 Knots at 30-Ft Keel Depth Six Minutes After Submerging

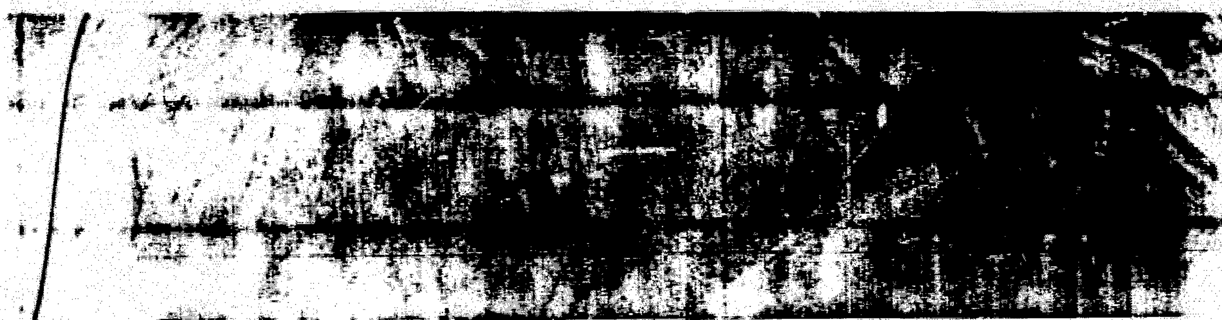

FIGURE 11 - Infrared Picture of Short Warm Wake from Midget Submarine Recorded Shortly After it Submerged

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FIGURE 12 - AN/AAD-2 with Liquid-Helium-Cooled Mercury Doped Germanium Detector Installed

FIGURE 13 - AN/AAD-2 Showing Recent Modifications

26 Aug 2016

MEMORANDUM FOR THE RECORD

FROM: Division Director EO & Special Mission Sensors, Avionics, Sensors and E* Warfare Dept (AIR 4.5.6

TO: Office of Counsel, Naval Air Warfare Center, Aircraft Division (NAWCAD)

Subj: SECURITY RECOMMENDAION FOR FOIA REQUEST, DON FOIA CASE FILE NUMBER 2015-008952

Ref: (a) SECNAVINST 5720.42F, DON FOIA Program, 06 Jan 99

(b) Executive Order 13526

1. Recommendation. AIR 4.5.6 reviewed each document and has the following recommendations listed by each separate document covered under the subject:

   a. Document (2) of Subj. NAVAIRDEVCEN Report No NADC-AW-N5916, 5 Jun 1959, "Submarine Wake Detection Program" (AD-C955796). Information found to be unclassified and releasable in its entirety.

   b. Document (3) of Subj. NAVAIRDEVCEN Report No NADC-AW-N5917, 8 Oct 1959, "Infrared Wake Detection" (AD-C955804). Information found to be unclassified and releasable in its entirety.

   c. Document (4) of Subj. NAVAIRDEVCEN Report No. NADC-AW-L5932, 23 Feb 1960, "Submarine Wake Detection" (AD-C955797). Portions of the report found to be classified under Section 3.3(4) under reference (b). Remaining portions of the document found to be unclassified and releasable.

   d. Document (5) of Subj. NAVAIRDEVCEN Report No. NADC-AW-L6005, 30 Mar 1962, "Submarine Wake Detection, Flight Trials of the Reconofax Camera" (AD-C955798). Information found to be unclassified and releasable in its entirety.

   e. Document (6) of Subj. NAVAIRDEVCEN Report No. NADC-AW-N6207, 3 May 1962, "Airborne Infrared Oceanographic Mapping" (AD-C955799). Information found to be unclassified and releasable in its entirety.

   f. Document (7) of Subj. NAVAIRDEVCEN Report No. NADC-AW-N6208, 8 Jun 1962, "NAVAIRDEVCEN Airborne Infrared Developments" (AD-C955801). Information found to be unclassified and releasable in its entirety.

   g. [redacted]

[redacted]

h. Document (11) of Subj. NAVAIRDEVCEN Report No. NADC-AW-N6304, 20 Jun 1963, "Use of an Airborne Passive Infrared Mapping Set for Submarine Wake Studies" (AD-338356L). Portions of the report are found to be exempted under reference (b) Section 3.3(6). Remaining portions of the document found to be unclassified and releasable.

i. Document (12) of Subj. NAVAIRDEVCEN Report No. NADC-AW-6303, 31 Jul 1963, Submarine Wake Detection, Flight Trials of the AN/AAD-2 Infrared Mapping Set in a Cessna 310-B Aircraft" (AD-340804). Information found to be unclassified and releasable in its entirety.

j. [redacted]

k. Document (14) of Subj. NAVAIRDEVCEN Report No. NADC-87161-50, 28 Oct 1987, "Applications of Airborne Passive Infrared Mapping Devices to Military Oceanography" (Reprinted from Proceedings of the First U.S. Navy Symposium on Military Oceanography, Volume II, 17-19 June 1964) (AD-C042316). Information found to be unclassified and releasable in its entirety.

l. Document (15) of Subj. NAVAIRDEVCEN Report No. NADC-AW-6421, 27 Aug-1964, "Infrared Radiation from Ships" (AD-353610L). Portions of the report found to be exempt under reference (b) Section 3.3(6). Remaining portions of the document found to be unclassified and releasable.

m. [redacted]

n. [redacted]

o. [redacted]

2. Basis of Recommendation. All information was reviewed with current class guides and what is considered open source information. Appropriate recommendations made above with respect to findings. Documents found with portions releasable were sanitized based on class guides and reference (b). Such disclosure of Department of the Navy classified information would give potential adversaries insight that would present a significant threat to national security.

3. Exemptions Utilized. Two separate exemptions were utilized in the determination of what information should be sanitized or exempted from release via Freedom of Information Act (FOIA) request process. All current Classified Military Information (CMI) has been sanitized out of the document under FOIA Exemption 3, Executive Order 13526 Sections 3.3(4) and 3.3(6). This Executive Order Section covers CMI that was originally classified over 25 years ago from date of this memorandum. Subject matter experts within AIR 4.5.6 were utilized in making the exemption determinations.

4. Point of Contact. The point of contact for this security review and recommendation is Mr. Paul W. Reimel, AIR 4.5.6 Division Director, paul.reimel@navy.mil, 301-342-0100.

8/30/2016

X Paul W. Reimel

Paul W. Reimel

Signed by: REIMEL.PAUL.W.1229241016

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